Propulsion plant feasibility study report.
Forecast for propulsion plant standards.

M. Rosenblatt and Son, Inc.

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PROPULSION PLANT FEASIBILITY STUDY REPORT

FORECAST FOR PROPULSION PLANT STANDARDS

DATE: JUNE 12, 1974
Rev. 6-15 a.l.
Rev. 9-25 a.l.

SAN DIEGO • NEW YORK • SAN FRANCISCO • WASHINGTON, D.C.

3.0 FORECAST

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3.0 FORECAST

3.1 INTRODUCTION

3.1.1 Purpose

The primary purpose of performance of this commercial shipbuilding forecast as the initial task of the propulsion plant standards feasibility study was to estimate the requirements for the propulsion equipment installations by United States shipyards between 1975 and 1985. The results indicate that the volume of shipbuilding forecast is sufficient to warrant the application of propulsion plant standards. The forecast establishes the basis for selecting candidate propulsion plant standards for analysis as potential cost effective items. Utilization of the results of the forecast will enable the determination of the types and priorities of propulsion plants for which standards should be considered.

3.1.2 Description

The forecast consists of estimates for ships 10,000 DWT or larger, by types and sizes, likely to be ordered from U.S. shipyards between 1975 and 1985, with an estimate of total U.S. shipbuilding extended to 1990. Estimates of propulsion equipment, by type and size and related acquisition costs corresponding to the ships forecast are included. The forecast includes plots of total ships ordered per year to 1990 and Deadweight Tons (DWT) ordered per ship type per year. The forecast was derived by first forming a baseline forecast. This base was modified by applying factors which represent the influence of current world affairs, U.S. legislation, and deviations from the base indicated by present shipyard order books. Data utilized in the research phase consisted of historical data of the past five years, current orderbook data and existing published and private forecasts.

3.1.3 Uncertainties

It is recognized that any forecast is vulnerable to speedy obsolescence due to unexpected changes in World politics, changes in governmental priorities and shortages of natural resources. Current factors whrich breed uncertainty are the Suez Canal reopening, the world material shortages (especially steel), fuel shortages, world-wide governmental enforcement of nationalistic commodity preferences and price inflation. However, it is believed that the results of the forecast can be intelligently applied to the propuision plant standards feasibility study by focusing attention on relative values, although the absolute values in the forecast may vary with time and events.

3.2 APPROACH TO FORECAST

3.2.1 Basic Data

A literature search was instituted and related data assembled from many publications. A list of the pertinent publications is included in the references, paragraph 3.5 in this report.

The most comprehensive forecast information available today is contained. in the Report of the Commission on American Shipbuilding, Reference 3-2. This report contains detailed information regarding the implementation of the 1970 Merchant Marine Act, detailed reports of forecast information related to specific events and programs which affect U.S. shipbuilding by noted research organizations, summaries of economic data and other related information regarding the various aspects of shipbuilding. Other references used for data collection generally refer to a specific portion of the total shipbuilding picture or deal only in generalities.

Two such examples are contained in "Economic Effects of Opening the Oil Reserves of Alaska through the TAPS", Ref. 3-9 which forecasts tankers for Alaskan crude only and Merchant Ship Demand to 1980", Ref. 3-6, which gives general data and formulae for preparing forecasts.

The baseline forecast consists of the foreign trade ships as listed in the "Report of the Commission on American Shipbuilding" and the domestic trade ships forecast by the U.S. Commerce Department. The baseline ships forecast is listed in Appendix A, Tables 3-16 and 3-17.

3.2.2 Forecast Modifiers

Two modifiers to the foreign trade baseline forecast which are also listed in Appendix A, Table 3-16 are taken from the same source as the baseline. These are due to "assisting shipbuilder" to reduce costs" and legislation "diverting U.S. import commodities to U.S. ships". The effect of diverting commodities to U.S. ships. as listed in the Commission report was somewhat reduced, since the final legislation enacted will probably be less restrictive than that described in the Commission report.

The modifier to the domestic trade baseline forecast is due to the initiation of the Trans-Alaskan Pipeline System (TAPS). Three forecasts of new ships, Refs 3-1, 3-9, 3-10, Appendix A, Tables 3-18, 3-19 and 3-20, required for this service were averaged.

The baseline forecast types and sizes of ships were reviewed and compared to ships ordered in the past five years and ships presently on the orderbooks. In addition, shipowners future preferences as indicated verbally and in correspondence, were considered. The baseline types and sizes of ships were adjusted for compatibility with these factors. For example, there were 27 bulk, carriers (or neo-bulk) in the baseline, but none on the orderbooks and none built in the last five years. in addition, 5.7 tankers per year were in the baseline forecast and 48 on the orderbooks. Therefore, bulk carriers were deleted and tankers adjusted upwards. For ships presently on order and ships ordered in the last five years refer to Appendix A, Tables 3-21 and 3-22.

Orderbooks and events, such as re-opening the Suez Canal and expected TAPS completion in 1977 dictated readjustment to decrease the number of large tankers and increase the quantity of smaller tankers forecast. This factor is reinforced by the need of-smaller tankers to service the deepwater terminals and ports which the great quantity of newly build VLCC'S and ULCC'S cannot enter.

The past history of shipbuilding in the U.S. has indicated that it is cyclical, having peak and poor years. This factor was utilized in estimating the annual building rates. The cycle was played against the Ten Year forecast with significant events, such as TAPS opening in 1977, accounting for forecast indicators which appear to have high confidence levels. The forecast for the period 1985 to 1990 is an extension of the cyclical curve, Figure 3-3.

The forecast for the projected building of LPG ships is based upon the Naritime Transport Research report "Merchant Ship Demand to 1980", Reference 3-6. The demand in the U.S. for LPG imports is estimated at approximately half that of LNG. The LPG shipbuilding forecast is therefore estimated at about half that of the LNG projection starting in the late 1970s. This same publication estimates that 46 LNG ships of 120,000 cubic meters capacity will be required by 1980. This quantity was integrated with the other forecasts for LNG ships and a ten year quantity of 44 was estimated.

3.2.3 Forecast Constraints

A review of shipyard capabilities was undertaken to determine whether the ships forecast were within practical constraints of U.S. shipyards. Refer to Appendix A, Table 3-23. Of special concern was the forecast of 225,000 to 265,000 DWT and 400,000 DWT tankers. Shipyards were questioned as to their expansion plans and capabilities.

Although it was difficult to determine actual shipyard limitations based upon physical facility constraints and even more difficult to determine limitations based upon available manpower, it was determined that the forecast rate of less than 40 commercial ships per year was well within the capabilities of the 14 major shipbuilders in the U.S. It is furthermore concluded that the capabilities of U.S. shipyards can vary greatly, depending upon the balance between U.S. Navy and commercial. shipbuilding programs. In addition, several of the major shipbuilders are in the process of expanding their facilities to enable building of the supertankers.

The numerical effect upon U.S. shipbuilding of re-opening of the Suez Canal is not included in this forecast. Existing. forecasts show minimal affect. However, legislation for diverting U-S. import commodities to U.S. shipping coupled with the

Suez Canal re-opening may alter these conclusions since a percentage of world shipping utilizing the Suez route which terminates in the U.S. will have to be carried in U.S. built ships. However, no estimates of the influence of these factors upon U.S. building forecasts have been uncovered to date.

3.2.4 Nuclear Propulsion

Nuclear propulsion has become more attractive as a competitive ships' propulsion plant since the fuel shortage. As the price of bunker fuel rises, nuclear propulsion may clearly be the most cost effective option for shipowners and operators.

est percentage of the total cost and farn. excess of the initial cost of a fossil fuel plant and since the cost of financing is one of the highest cost factors in shipbuilding, it is estimated that nuclear propulsion plants will not be popular until after 1985. There have been several requests to the Maritime Administration for subsidies for nuclear propelled ships, but these have been refused *to* date.

The economics and regulations pertaining to nuclear plants dictate that only large propulsion plants for large ships are practical (A 120,000 SHP plant has been designed). This fact coupled with the forecast to 1985 of ships with required horsepowers of mostly less than 60,000 SHP (and a maximum of 100,000 SHP) reinforce these conclusions. In addition, it must be recognized that the new nuclear ships built in France and Japan are having difficulty obtaining harbor clearances due to environmental problems.

It is also recognized that when nuclear propulsion is accepted by the marine industry, the power plant design will be under strict regulation-enforced by government agencies. Practically there probably will be a limited number of designs. For these reasons nuclear propulsion has been eliminated from further consideration for determining propulsion plant standards in this program.

3.2.5 Diesel Engines

There has been no utilization of large slow speed diesel engines for ships propulsion in the U.S. in the past and there will likely be none in the forseeable future. In order to receive MARAD subsidy a builder must "buy American" and to date no large slow speed diesel has been built in the U.S. The maximum practical size propulsion diesel engine available in the U.S. is about 14,000 BHP (medium speed diesel). Utilizing two units, approximately 20,000 to 24,000 SHP could be available practically for ships propulsion. However, historically in the U.S. few diesel ships have exceeded 12,000 to 14,000 SHP with multiple diesel engines. It is therefore concluded that slow speed diesels will not be utilized in the U.S. to any-extent during the period of performance of this program and that medium speed diesel. ships will be limited to a maximum of 24,000 SHP.

3.3 FORECAST DATA

3.3.1 Description

The forecast is summarized in Matrix form, Table 3-1 which lists all ships likely to be ordered by type and size in each year to 1985. Included are domestic trades ships (Jones Act type) and foreign trade ships which include ships expected to be ordered under the Construction Differential Subsidy (CDS). Figures for 1973 reflecet actual orders. The matrix, Table 3-2 lists the domestic trade and foreign trade ships separately by year.

A graph, Figure 3-3, shows all ships to be ordered by year to 1985 with an extended projection to 1990. The points for years 1969 to 1973 are actual ships ordered (see Appendix A, Table 3-22) . Also shown are graphs indicating domestic trade ships and foreign trade ships ordered for each year to 1985. The graph emphasizes the cyclical nature of the shipbuilding business.

Propulsion plants corresponding to ships forecast are listed in matrices by type and size and year ordered, Tables 3-4.1, 3-4.2, 3-5 and 3-6.

Equipment Acquisition cost estimates by year for propulsion plants required for the forecast shipbuilding program are listed in Table 3-7.

A chart of deadweight tonnage (DWT) for each type of ship forecast is plotted versus year in which ordered, figures 3-8 to 3-15, Appendix A.

SHIP TYPE	DWTX1000	74-83 10 YEAR TOTAL	SUB-TOTAL 1974 - 1983 F	D	1973 ACTUAL	74	75	76	77	78	79	80	81	82	83	84	85	76-85 10 YEA TOTAL
Container Carrier	14.6-20	18	10	8	-	4	2	2	1	-	-	1	2	2	4	4	4	20
RO/RO Ship	14.1-20	16	8	8	-	2	2	1	1	-	1	2	2	2	3	3	3	18
Barge Carrier	22-28	32	32	-	-	4	3	3	2	3	3	3	3	3	5	4	4	33
Bulk Carrier	19,29,80	33	33	-	5	4	3	3	2	3	3	3	3	4	5	5	5	36
OBO Carrier	80	6	6	-	-	-	1	1	1	-	1	-	1	1	-	1	-	6
LNG Ship	64-100	44	44	-	9	4	5	5	5	5	4	4	4	4	4	4	4	43
LPG Ship	27-45	14	14	-	-	-	-	1	1	2	2	2	2	2	2	2	2	18
Oil Tankers	25-37	70	41	29	9	10	9	9	6	5	5	6	6	7	7	6	7	64
Oil Tankers	70-90	62	10	52	10	6	7	6	7	6	6	6	6	6	6	7	6	62
Oil Tankers	120-150	20	5	15	-	2	1	2	2	2	3	3	3	1	1	1	1	19
Oil Tankers	225-265	24	17	7	3	2	4	4	3	2	2	2	2	2	1	1	1	20
Oil Tankers	400	14	14	-	-	-	1	1	2	2	2	2	2	1	1	1	1	15
TOTAL		353	234	119	36	38	38	38	33	30	32	34	36	35	39	39	38	354

DESIGNATION OF SYMBOLS: F = FOREIGN TRADE SHIPS (INCLUDES CONSTRUCTION DIFFERENTIAL SUBSIDY SHIPS)
D - DOMESTIC TRADE SHIPS (JONES ACT)

FORECAST OF SHIPS TO BE CONTRACTED FOR IN U.S. SHIPYARDS

TABLE 3-1

SHIP TYPE	$DWT \times 10^{-3}$	1974		1975		1976		1977		1978		1979		1980		1981		1982		1983		1984		1985	
		F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D	F	D
Container	14.6-20	2	2	1	1	1	1	1	-	-	-	-	-	1	-	1	1	1	1	2	2	2	2	2	2
RO/RO	14.1-20	1	1	1	1	1	-	-	1A	-	-	1	-	1	1	1	1	1	1	1	2	2		1	2
Barge Carrier	22-28	4	-	3	-	3	-	2	-	3	-	3	-	3	-	3	-	3	-	5	-	4	-	-	-
Bulk	19-29,80	4	-	3	-	3	-	2	-	3	-	3	-	3	-	3	-	4	-	5	-	5	-	5	-
OBO	80	-	-	1	-	1	-	1	-	-	-	1	-	-	-	1	-	1	-	-	-	1	-	-	-
LNG	64-100	4	-	5	-	5	-	5	-	5	-	4	-	4	-	4	-	4	-	4	-	4	-	4	-
LPG	27-45	-	-	-	-	1	-	1	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-	2	-
Oil Tankers	25-37	6	4	5	4	5	4	4	1A 1	3	2A	3	1A 1	4	2	3	3	4	3	4	3	3		4	3
Oil Tankers	70-90	1	5	1	6	1	2A 3	1	3A 3	1	2 3A	1	2A 3	1	5	1	5	1	5	1	5	2	5	1	5
Oil Tankers	120-150	1	1	1	-	1	1	1	1	-	2A	-	3A	-	3A	-	3A	-	1	1	-	1	-	1	-
Oil Tankers	225-265	2	-	4	-	4	-	3	-	2	-	1	1A	-	2A	-	2A	1	1A	-	1A	1	-	1	-
Oil Tankers	400	-	-	1	-	1	-	2	-	2	-	2	-	2	-	2	-	1	-	1	-	1	-	1	-
TOTAL		21	13	26	12	27	11	23	10	21	9	21	11	21	13	21	15	23	12	26	13	28	11	26	12

DESIGNATION OF SYMBOLS: F = Foreign Trade Ships (Includes Construction Differential Subsidy Ships)
D = Domestic Trade Ships (Jones Act)
A = Ships Designated for Alaskan Pipeline Service

FORECAST OF SHIPS BY FOREIGN AND DOMESTIC TRADE

TABLE 3-2

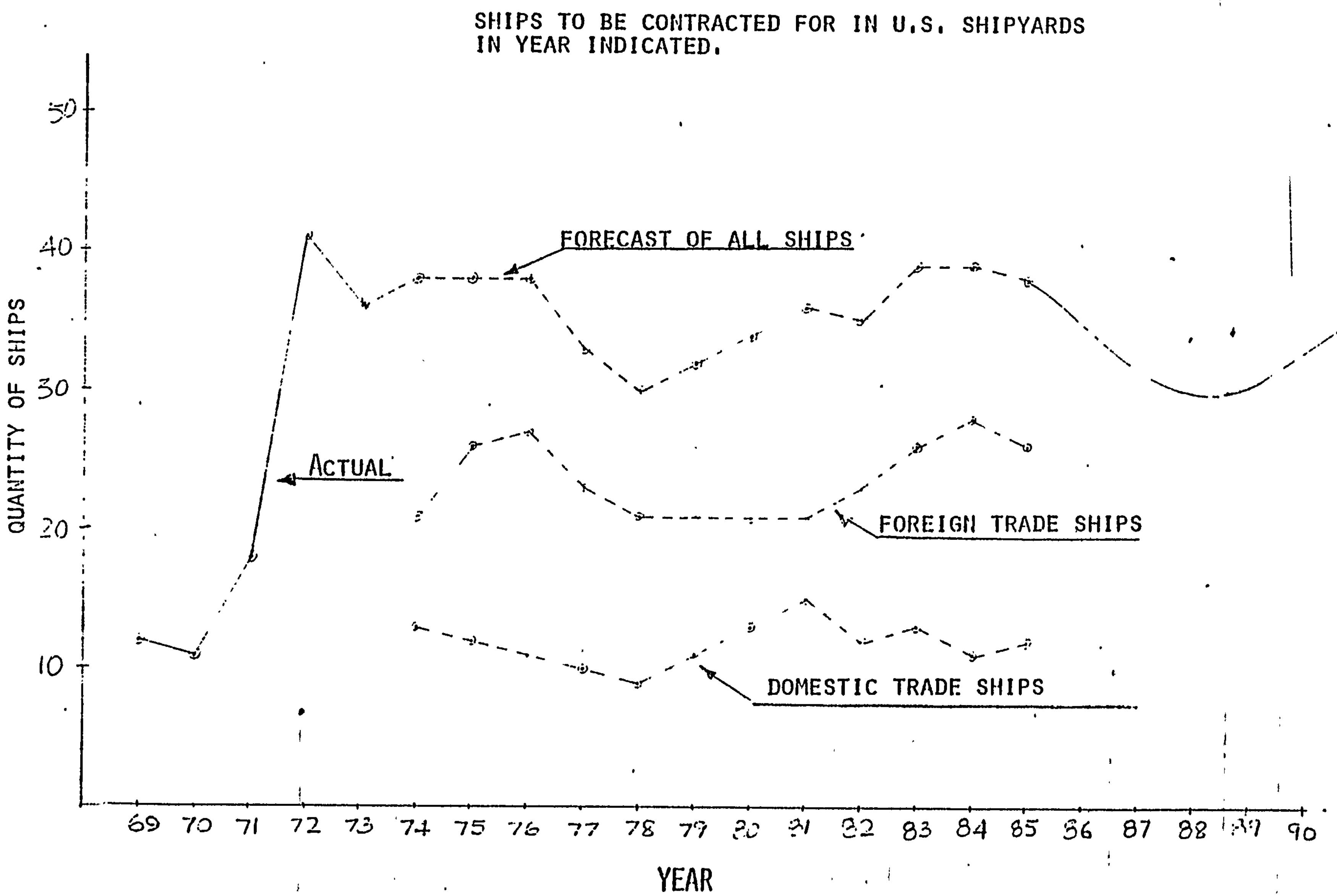


FIG. 3-3

FORECAST FOR U.S. COMMERCIAL SHIPS

SHPX1000 YEAR	15-17.5	24-26	28.5-32	36-40	43-45	-50	TOTAL
1974	3	6	3	10	3	2	27
1975	2	7	2	14	2	1	28
1976	1	8	3	10	4	2	28
1977	2	7	3	9	2	-	23
1978	1	8	2	8	2	1	22
1979	-	9	2	6	1	1	19
1980	1	7	2	5	2	-	17
1981	-	7	2	7	1	1	18
1982	1	4	2	7	1	-	15
1983	1	4	2	6	-	1	14
1984	-	5	2	5	1	1	14
1985	1	4	2	5	1	1	14
TOTAL	13	76	27	92	20	11	239

FORECAST OF STEAM TURBINE PROPULSION PLANTS

BY SHP TO 1985

TABLE 3-4.1

STEAM PLANT CYCLE	RANGE SHP 10^{-3}	74	75	76	77	78	79	80	81	82	83	84	85	TEN-YEAR TOTALS
Two Boilers	16	3	2	1	2	1	-	1	-	1	1	-	1	13
Two Stage-Heating	25	6	7	8	7	8	9	6	6	3	3	5	4	72
	30	3	2	3	3	2	2	1	1	1	2	2	2	24
Two Boiler	37	10	14	10	9	8	6	4	6	6	5	5	5	88
Four Stage-Heating	44	3	2	4	2	2	1	1	-	1	-	-	1	17
	50	2	1	2	-	1	1	-	1	-	-	-	1	9
One Boiler - Two Heaters	25	-	-	-	-	-	-	1	1	1	1	-	-	4
	30	-	-	-	-	-	-	1	1	1	-	-	-	3
One Boiler- Four Heaters	37	-	-	-	-	-	-	1	1	1	1	-	-	4
Reheat Cycle	44	-	-	-	-	-	-	1	1	-	-	1	-	3
	50	-	-	-	-	-	-	-	-	1	1	-	-	2
TOTAL NO. OF PLANTS		27	28	28	23	22	19	17	18	16	14	13	14	239

TEN-YEAR TOTALS BY TYPE OF CYCLE

Two Boilers-Two Heaters:	109
Two Boilers-Four Heaters:	114
One Boiler-Two Heaters:	7
One Boiler-Four Heaters:	4
Reheat Cycle:	5
TOTAL	239

STEAM PLANT FORECAST BY CYCLE TYPE

TABLE 3-4.2

SHPX1000 YEAR	12.5	25	30	35	40	60	TOTAL
1974	3	1	-	-	-	-	4
1975	3	-	1	-	-	-	4
1976	3	-	1	-	-	-	4
1977	2	-	3	-	-	-	5
1978	2	-	3	-	-	-	5
1979	2	-	4	1	1	-	8
1980	2	1	3	1	1	1	9
1981	3	1	5	2	1	1	13
1982	3	2	5	2	2	1	15
1983	3	2	4	4	1	4	18
1984	3	2	5	3	1	3	17
1985	3	2	5	3	1	3	17
TOTALS	32	11	39	16	8	13	119

FORECAST OF GAS TURBINE PROPULSION PLANTS

BY SHP TO 1985

TABLE 3-5

SHPX1000 / YEAR	7	14	28	TOTAL
1974	4	6	-	10
1975	2	5	-	7
1976	2	5	-	7
1977	2	3	1	6
1978	2	3	-	5
1979	2	4	-	6
1980	2	4	2	8
1981	2	4	2	8
11982	2	4	2	8
1983	2	4	2	8
1984	2	4	2	9
1985	2	4	2	8
TOTAL	26	50	14	90

FORECAST OF DIESEL PROPULSION PLANTS

BY SHP TO 1985

TABLE 3-6

POWER PLANT YEAR	STEAM TURBINE PROPULSION PLANTS: TWO-HEATERS TWO-BOILERS	FOUR-HEATERS TWO BOILERS	TWO-HEATERS ONE BOILER	FOUR-HEATERS ONE BOILER	REHEAT CYCLE	HEAVY-DUTY GAS TURBINE	MEDIUM SPEED DIESEL	TOTAL
	MILLIONS OF DOLLARS							
1974	79.2	132.24	-	-	-	18.69	37	267.13
1975	73.13	147.05	-	-	-	19.26	27.1	266.54
1976	81.91	141.48	-	-	-	19.26	27.1	269.75
1977	80.56	94.8	-	-	-	28.15	25.14	228.65
1978	74.49	96.18	-	-	-	28.15	18.5	217.32
1979	75.85	69.97	-	-	-	49.37	22.8	217.99
1980	53.51	43.16	14.31	8.62	9.48	65.16	36.08	230.32
1981	48.09	60.73	14.31	8.62	9.48	82.51	36.08	259.82
1982	33.18	60.12	14.31	8.62	-	110.25	36.08	262.56
1983	40.6	42.39	6.82	8.62	10.08	116.87	36.08	261.46
1984	48.74	42.39	-	-	10.56	114.15	42.72	258.56
1985	47.38	61.5	-	-	-	114.15	36.08	259.11
TOTAL	736.64	992.01	49.75	34.48	39.6	766.32	280.76	2999.56

NOTES: 1. These figures are based upon the propulsion plant machinery and ships forecast in this report.
2. The costs were estimated utilizing the SNAME paper "ECONOMIC COMPARISON OF VARIOUS MARINE POWER PLANTS" by Jose Femenia and applying a 6% per annum inflation factor to arrive at 1974 dollars.

PROPULSION PLANT FUTURE ACQUISITION COSTS BASED ON JULY 1974 PRICES

TABLE 3-7

3.3.2 Discussion

A review of the forecast data indicates that the total quantity of new construction ordered will vary between 30 and 39 ships per year.. A drop in the quantity of container ships to be ordered in the late 1970's reflects the industry prognistications of over production of ships. Applying the cyclic characteristics of shipbuilding and assuming that the demand for container. trade would resume in the early 1980's we have estimated a re-interest in container ships. Roll-On Roll-Off ships demand was assumed to follow this same trend.

Barge carrier demand and forecast was assumed to remain fairly constant over the years based upon a fair demand and the steady but limited capacity of the shipyards to build this type of ship. Bulk carriers were expected to follow this same steady building demand. The demand for OBO'S in this country is fairly low and is so indicated by the forecast of six over a ten-year period. This is substantiated by the fact that only one is on present orderbooks.

The quantity of LNG ships and LPG ships forecast was discussed in paragraph 3.2.2. The LNG forecast of 4.4 ships ordered-per year is supported by the present orderbook quantity of 18 which equates to approximately 4.5 ships per year. The LPG skip forecast is based upon an estimate of LPG demand in the U.S. There are presently no LPG ships on order.

The tanker forecast is discussed in paragraph 3.2.2. A total of 48 tankers are presently on order which equates to approximately 16 per-year. The ten-year forecast of all tankers is 190 or an average of 19 per year. The higher amount in the

the forecast over the orderbook estimate is due to the additional influence of the Trans-Alaskan Pipeline System (TAPS).

Industry forecasts a drop in demand for world-wide tankers based upon the recent extremely high production of VLCC'S. However, the reduced demand is not expected to affect the U.S. because of the support required to the TAPS and the additionally required smal1 feeder tankers to shuttle between large tanker terminals and U.S. ports.

3.3.3 Cost Estimates

The estimate of acquisition costs corresponding to the propulsion plant forecasts (Table 3-7) was based on "Economic Comparison of Various Marine Power Plants" by Jose' Femenia. The average shipyard unit labor cost, including benefits and overhead was assumed to be $ 11.0 according to constant 1974 dollars.

Three different types of steam propulsion plants were included in the cost analysis; the" two-heater cycle, the four heater cycle and the reheat cycle. In addition, a one boiler arrangement was included. The estimated quantities of each are based upon recent utilization and owners comments on preference. (Refer to Table 3-4.2 for breakdown of types).

The equations for acquisition costs of different types of marine. steam power plants are:

TWO BOILER, FOUR HEATER PLANTS: $A = 44067.6\ (SHP)^{0:5}$

SINGLE BOILER, TWO HEATER PLANTS: $A = 38589\ (SHP)^{0.511}$

SINGLE BOILER FOUR HEATER PLANTS: $A = 42936\ (SHP)^{0.504}$

REHEAT CYCLE PLANTS: $A = 51928\ (SHP)^{0.487}$

where A is acquisition cost in dollars.

It was estimated that an equivalent two-heater cycle plant would cost 2 3/4 percent less than the four-heater cycle plant, and the reheat cycle plant would cost 3 1/2 percent more than the four-heater cycle plant.

Heavy-duty gas turbine plants are assumed to consist of a single heavy-duty gas turbine fitted with a generator driving either a fixed pitch propeller through a reversing reduction gear, or a controllable pitch propeller through a non-reversing reduction gear. Below 30,000 SHP the cost difference between these two appear to be negligible. The heavy-duty" gas turbines were assumed to be capable of burning treated residual oil (Bunker "C").

The acquisition cost of a heavy-duty gas turbine plant is:

$$A = 37874 \quad (SHP) \quad 0.5"$$

where A is acquisition cost in dollars.

The medium-speed diesel machinery plants were assumed to have one or more reversible medium speed diesel engines coupled to a single fixed-blade propeller via a-single reduction gear and suitable shafting.

The acquisition cost of a medium speed diesel engine plant is expressed by:

$$A = 11374 \ (SHP) \ 0.622$$

where A is acquisition, cost in dollars.

The summary" of estimated acquisition costs are tabulated in Table 3-7. The single boiler propulsion plant is forecasted in the 1980's. The reheat cycle power plant is also forecasted for the 1980's. The acquisition cost of reheat cycle was. relatively higher than that of regenerative cycle.

As shown in Table 3-4.2, nominal SHP values of 16, 25, 30, 37, 44 and 50 thousand SHP were chosen for steam propulsion plants in computing acquisition costs. The heavy-duty gas turbine and medium speed diesel propulsion plant sizes were chosen as in the forecasts of Tables, 3-5 and 3-6 respectively.

Cost reduction factors due to multiple ship purchasing were not used in acquisition cost estimates.

3.3.4 Influence of the Marine Market

A determination was made of the influence of the marine market upon the total sales of equipment suppliers in order to predict the acceptance of marine standards and to ascertain the effects upon the equipment suppliers of enforcing marine equipment standards.

In most cases the major equipment suppliers largest sales are in the shore based-power plant field or in the oil drilling industry. The marine industry sales are usually less than five percent of total sales. In a few cases the marine market was the only market of a particular supplier, but this was a rare case. The data gathered relative to this subject is of a proprietary nature and is not included in the report. However, the data is available for substantiation of results at M. Rosenblatt E Son, Inc. It is therefore concluded that any standards which are incorporated as a result of this program must of necessity be with the cooperation of the equipment manufacturers and Suppliers. It should also be noted that a large percentage of the equipment suppliers have standardized their own product lines and may resist any changes imposed by national or industry standards.

3.4 CONCLUSIONS

3.4.1 Overview

A review of the forecast data indicates that the U.S. shipbuilding demand is generally good and will probably continue in this manner for a ten to fifteen year period. Most shipyards are working at a high capacity on commercial shipbuilding. This conclusion is reinforced by the poor response to recent requests for bids for building Naval ships. The general outlook is for a total ships order of between 30 and 39 per year with peaks in the mid 1970's and mid 1980's. One factor which may complicate the generally optimistic outlook is the probable continued shortages of materials compared to demand, in the next ten years. This adversely affects shipyard expansion plans. as well as the supply of materials for building the ships.

3.4.2 Priority of Propulsion Plants

Investigation of probable equipment requirements for propulsion of the forecast ships leads to the conclusion that most of the effort in this study should be placed upon steam turbine, fossil fueled propulsion plants, since the major portion of ships to be ordered in the U.S. will have steam propulsion.

Gas Turbines and Diesel Engines will share the secondary effort in the following candidate selection task.

Refer to Tables 3-4 to 3-6 for quantities of each propulsion plant type and size forecast.

3.5 REFERENCE DOCUMENTS

3-1 "ANALYSIS OF THE MARKET FOR U.S. FLAG TANKERS"
(James A. Cross, May 12, 1969)

3-2 "REPORT OF THE COMMISS1ON ON AMERICAN Shipbuilding"
(October, '1973)

3-3 "A FORECAST" OF 1970-1985 WORLD SHIPPING"
(Robert W. V. Wiederker, September 1, 1971)

3-4 "AN OBJECTIVE LOOK AT SHIPBUILDING IN THE U.S."
(Edwin M. Hood and Nathan Sonenshein (SNAME)
(June, 1968)

3-5 "TRADE FORECASTING"
(John F. wing & John F. Hillman (SNAME) (May, 1972)

3-6 "MERCHANT SHIP DEMAND TO 1980"
(March '73 and '74, Maritime Transport Research)

3-7 "TECHNOLOGICAL FORECASTS 1975-2000"
(Department of Transportation, May, 1970)

3-8 "'ASPECTS OF SHIP MANUFACTURING REQUIREMENTS FOR INCREASED PRODUCTIVITY"
(E. G. Frankel, April, 1968
Massachusetts Institute of Technology)

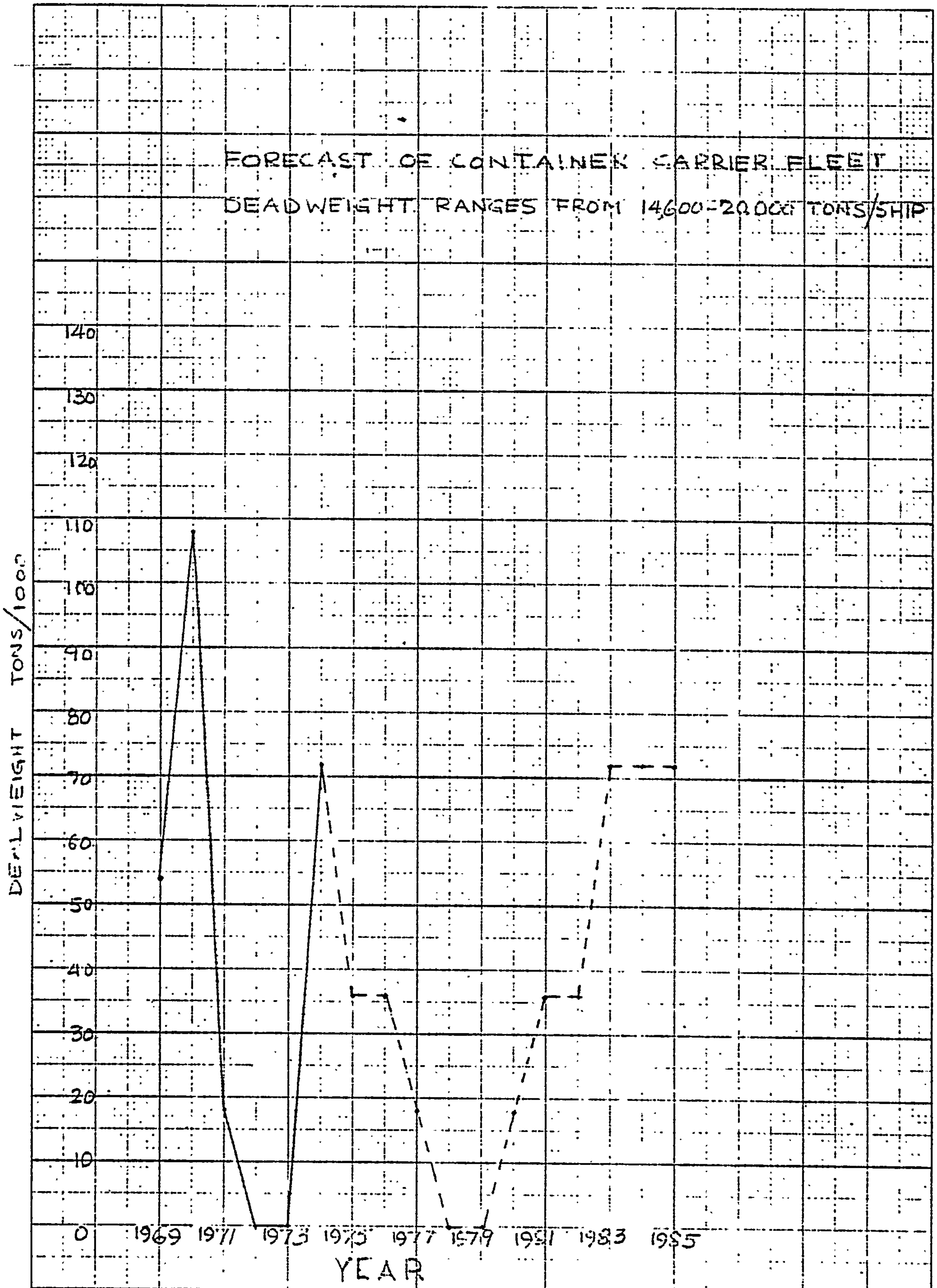
3-9 "ECONOMIC EFFECT OF OPENING THE OIL RESERVES THROUGH THE TRANS-ALASKA PIPELINE SYSTEM"

3-1o "ALYESKA PIPELINE SERVICE COMPANY FORECAST REPORT"

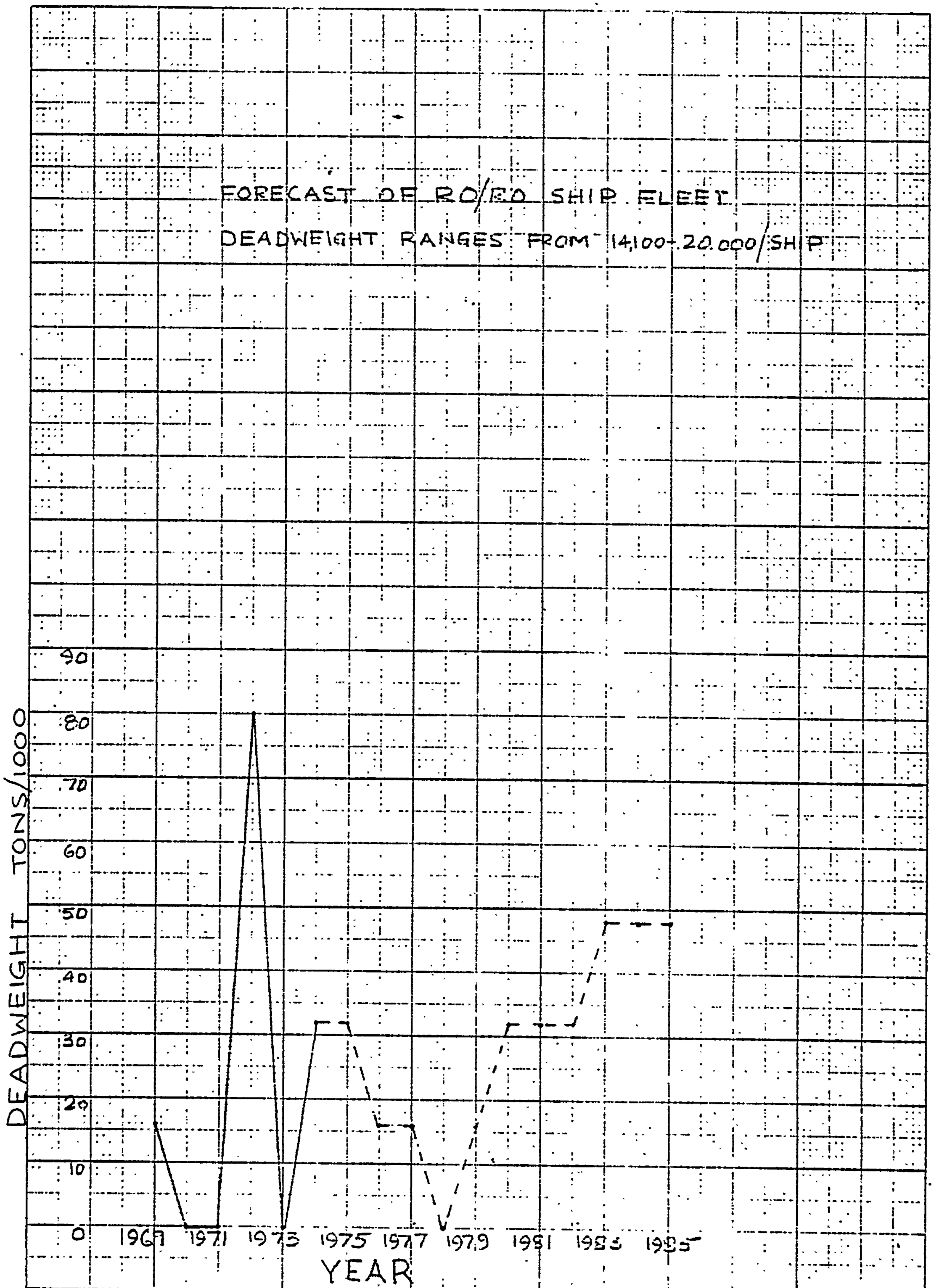
APPENDIX A

The information contained in this section was obtained from sources noted and was used to derive the forecast data as described within the text of section

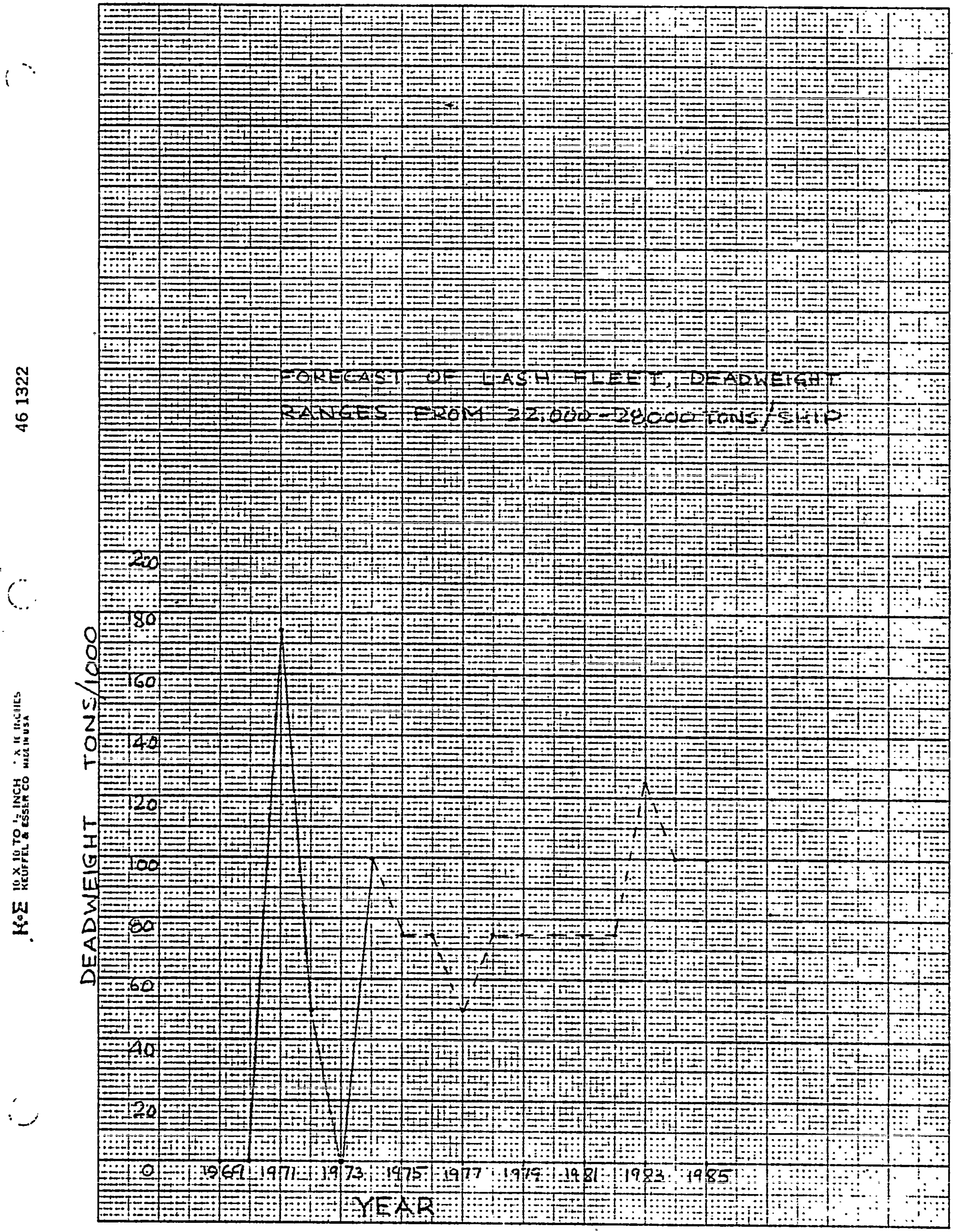
APPENDIX A


FORECAST OF CONTAINER CARRIER FLEET
DEADWEIGHT RANGES FROM 14600-20000 TONS/SHIP
DEADWEIGHT TONS/1000
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1969
1971
1973
1975
1977
1979
1981
1983
1985
YEAR

APPENDIX A

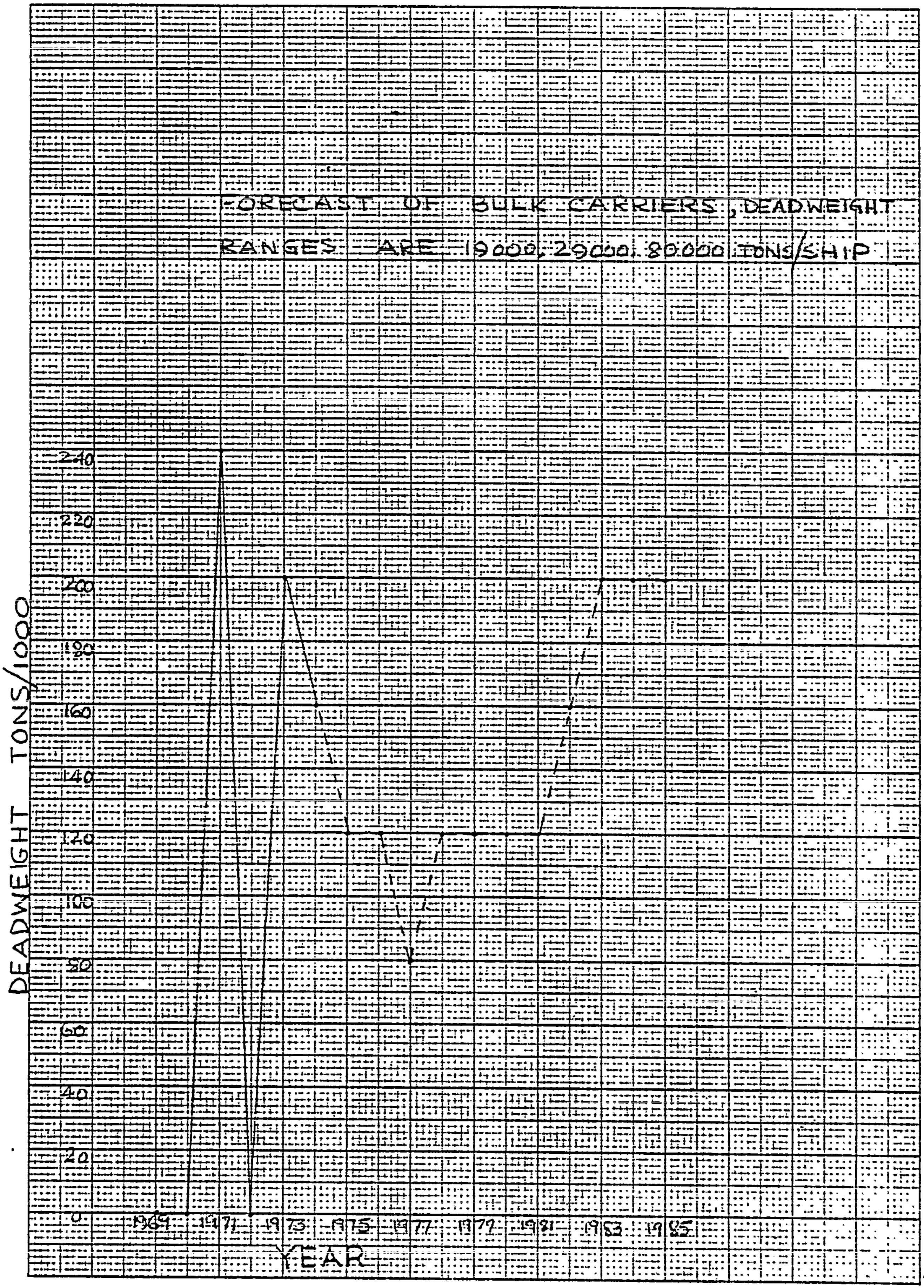

FORECAST OF RO/RO SHIP FLEET
DEADWEIGHT RANGES FROM 14,100-20,000/SHIP
DEADWEIGHT TONS/1000
90
80
70
60
50
40
30
20
10
0
1969
1971
1973
1975
1977
1979
1981
1983
1985
YEAR

APPENDIX A



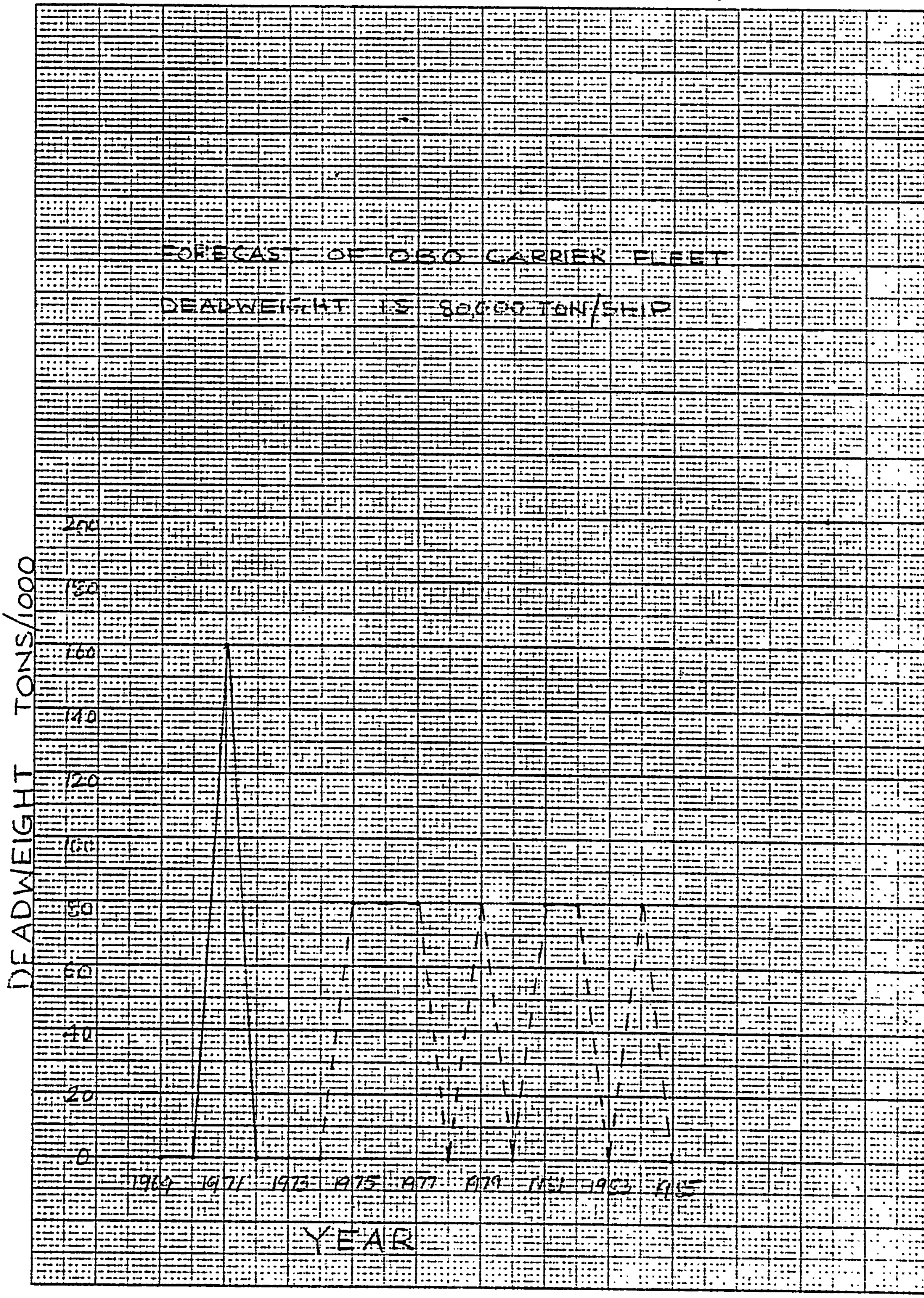
FORECAST OF LASH FLEET, DEADWEIGHT
RANGES FROM 22,000-28,000 TONS/SHIP
DEADWEIGHT TONS/1000
200
180
160
140
120
100
80
60
40
20
0
1969
1971
1973
1975
1977
1979
1981
1983
1985
YEAR
46 1322
K&E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN USA

APPENDIX A



FORECAST OF BULK CARRIERS, DEADWEIGHT
RANGES ARE 19000, 29000, 80000 TONS/SHIP
DEADWEIGHT TONS/1000
240
220
200
180
160
140
120
100
80
60
40
20
0
1969
1971
1973
1975
1977
1979
1981
1983
1985
YEAR

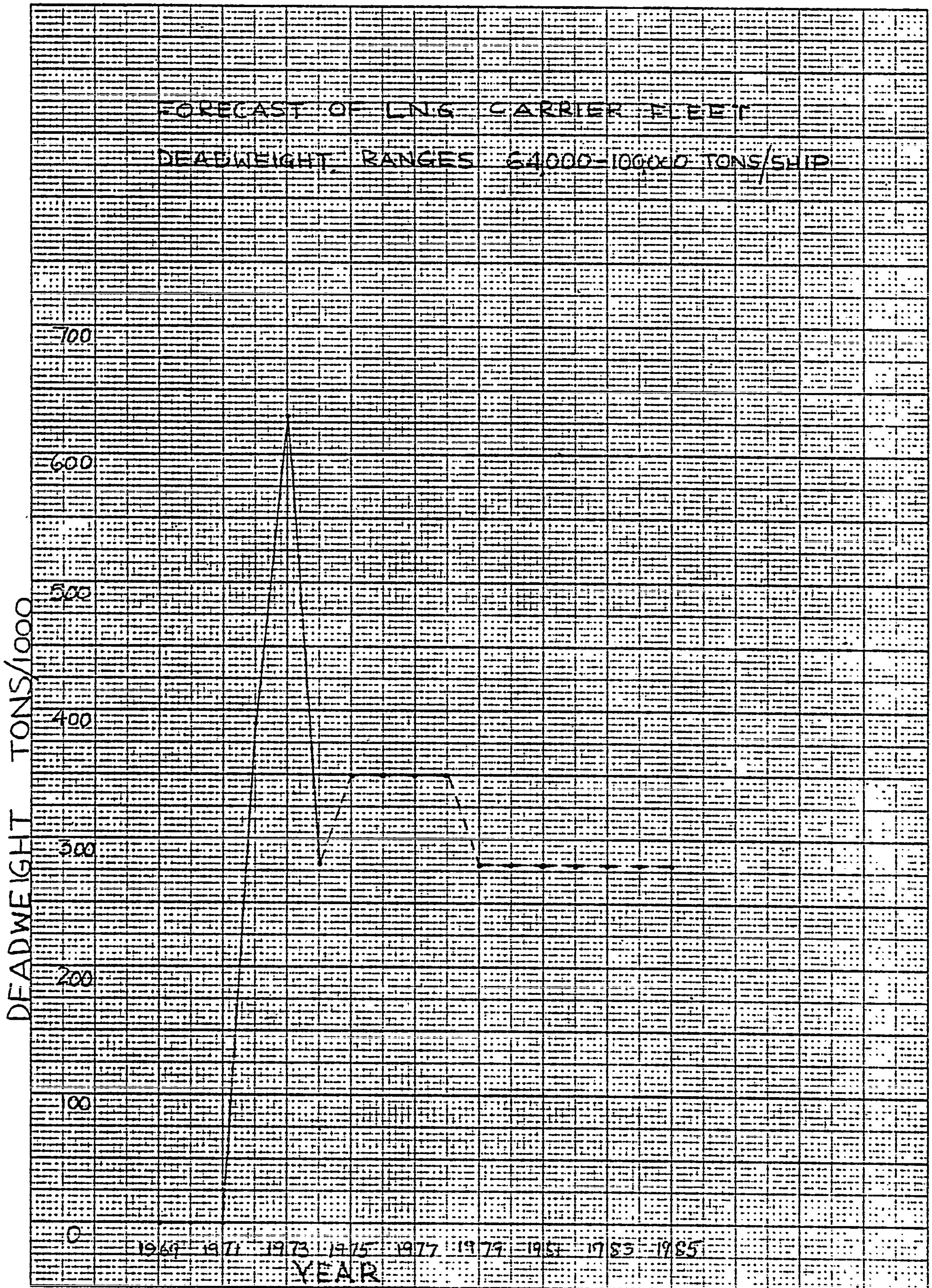
APPENDIX A



K&E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A. 46 1322

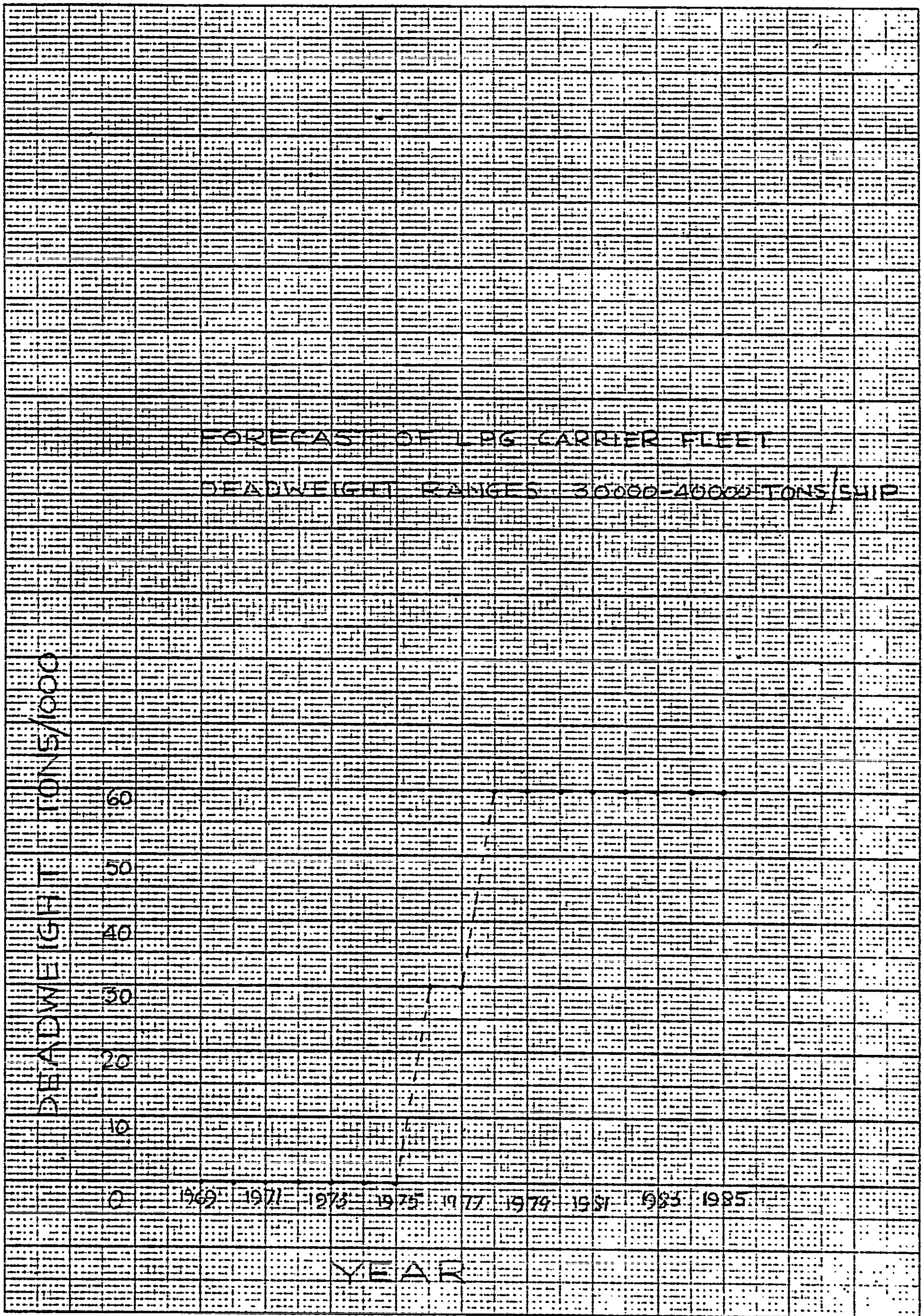
FIG. 18

APPENDIX A

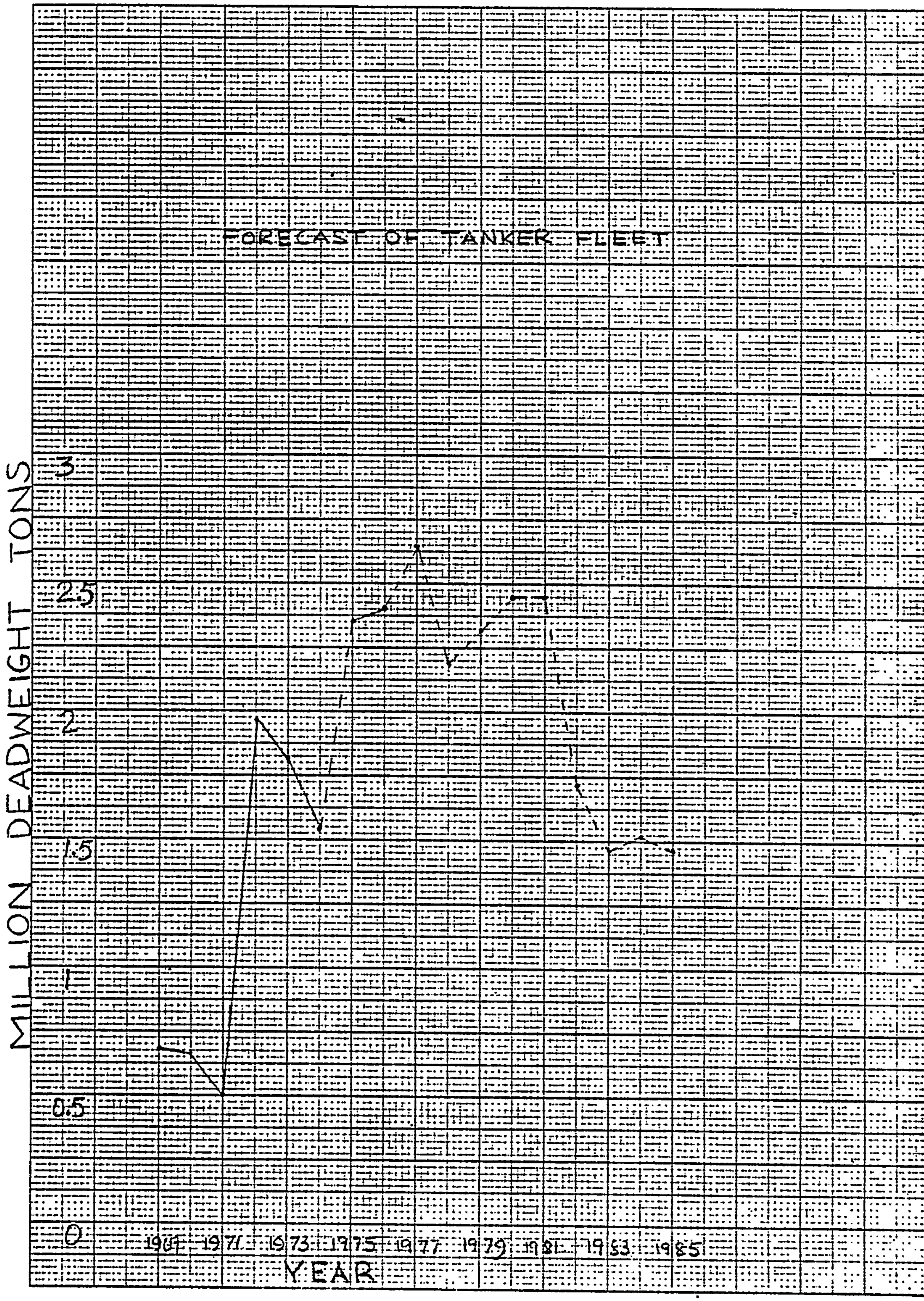


FORECAST OF LNG CARRIER FLEET
DEADWEIGHT RANGES 64000-100,000 TONS/SHIP
DEADWEIGHT TONS/1000
700
600
500
400
300
200
100
0
1969
1971
1973
1975
1977
1979
1981
1983
1985
YEAR

APPENDIX A


FORECAST OF LPG CARRIER FLEET
DEADWEIGHT RANGES 30000-40000 TONS/SHIP
DEADWEIGHT TONS/1000
60
50
40
30
20
10
0
1969
1971
1973
1975
1977
1979
1981
1983
1985
YEAR

APPENDIX A



FORECAST OF TANKER FLEET
MILLION DEADWEIGHT TONS
3
2.5
2
1.5
1
0.5
0
1969
1971
1973
1975
1977
1979
1981
1983
1985
YEAR

APPENDIX A

TEN-YEAR TOTALS

TYPE	SIZE (DWT)	MM 70	ASSIST BUILDERS	DIVERT COMMODITIES
Container	14,000	10	10	10
RO/RO	20,000	8	8	8
Barge Carrier	(22,000) (27,000)	32	32	32
Freighter	14,600	27	27	27
Dry Bulk	51,000	6	6	6
OBO	80,500	6	6	6
Tanker	37,000	17	17	17
Tanker	80-88,000	7	7	45-49
Tanker	120,000	13	13	7-45
Tanker	225,265,000	20	20	31-91
LNG (124,000 CM)	64,000	32	55	32
TOTAL NUMBER OF SHIPS		178	201	221-323

Ref: "Report of the Commission on American Shipbuilding"
(October, 1973, Volume III, Pages 847, 990

NEW SHIP CONSTRUCTION BY TYPE AND SIZE

Foreign Trade Ships Baseline

TABLE 3-16

TEN-YEAR TOTALS

TYPE	SIZE (DWT)	NUMBER	TOTAL CAPACITY X1000 DWT
Tankers	25,000	9	225
Tankers	70,000	57	3,990
Tankers	120,000	4	480
Containers	14,600	8	117
RO/RO	14,180	1	14
	20,000	7	140
TOTALS		86	4,966

Ref: "Report of the Commission on American Shipbuilding"
(October, 1973, Volume III, Page 848

NEW SHIP CONSTRUCTION BY TYPE AND SIZE

Domestic Trade Ships Baseline

TABLE 3-17

	8	250,000 DWT TANKERS
	16	120,000 DWT TANKERS
	1	90,000 DWT TANKERS
	2	80,000 DWT TANKERS
	4	75,000 DWT TANKERS
	6	70,000 DWT TANKERS
	2	60,000 DWT TANKERS
	2	45,000 DWT TANKERS
TOTAL	41	

NOTE: From the Commerce Department Report on "Economic Effects of Opening the Oil Reserves of Alaska Through the Trans-Alaska Pipeline System." Of the forty-one tankers, only eight would come from the existing fleet and thirty-three would have to be built in U.S. shipyards.

ALASKA PIPELINE SUPPORT SHIPS, REF.

TABLE 3-18

	1	150,000 DWT
	5	130,000 DWT
	16	120,000 DWT
	2	90,000 DWT
	2	80,000 DWT
	3	75,000 DWT
	2	70,000 DWT
	3	60,000 DWT
	1	45,000 DWT
TOTAL	35	

NOTE: From Alyeska Pipeline Service Company Report upon completion of TAPS by 1977, thirty-five U.S. built tankers would be required to transport oil from Valdez to West Coast ports, twenty-seven of which are yet to be built.

ALASKA PIPELINE SUPPORT SHIPS, REF.

TABLE 3-19

	1980 VOLUME MILLIONS OF B/D	LARGE TANKERS 250,000 DWT EQUIVALENTS	EAST COAST TANKERS 70,000 DWT EQUIVALENTS
WEST COAST VIA ALASKAN P/L	1.2	9	
EAST COAST VIA PANAMA P/L	1.0	16	24

Note that we have used the concept 250,000 DWT, 16 Knot vessel as the measure of carrying capacity for tankers which would be employed on the north slope run.

The 250,000 DWT prototype tanker, although none has yet been built in the United States is representative of the size vessel which could be used in West Coast service. Also, the same size vessel designed for service through ice could be used on the Alaska to East Coast run if protected deep water terminals near East Coast. Refining centers are developed.

A 70,000 DWT, 17 Knot tanker represents the size range likely to be used in Gulf to East Coast trade in the absence of construction of deep water terminal facilities.

NOTE: Abstracted from James S. Cross "Analysis of the Market for U.S. Flag Tankers", Ref.

TANKERS REQUIRED TO TRANSPORT NORTH ALASKAN CRUDE

TABLE 3-20

APPENDIX A

SHIP TYPE	QUANTITY	DWTX1000	SHPX1000	TYPE MACHINERY
TANKER	6	35	12.5	GT-E
	9	25	14	DIESEL
	4	35	14	DIESEL TWIN SCREW
	7	87	24.5	TURBINE
	5	38	15	TURBINE
	1	8	4.4	DIESEL TWIN SCREW
	2	120	26	TURBINE
	3	265	31.5	TURBINE
	2	267	36	TURBINE
	2	225	50	TURBINE
	6	90	24.5	TURBINE
	1	118	30	TURBINE
TOTAL	48			
LNG TANKER	7	64	43	TURBINE
	3	63	45	TURBINE
	3	63	40	TURBINE
	2	70	100	TURBINE
	3	63.4	40	TURBINE
TOTAL	18			
CONTAINER CARRIER	1	20	32	TURBINE
TOTAL	1			
RO/RO SHIP	3	20	37	TURBINE
	1	14	30	TURBINE
	1	18.5	37	TURBINE
TOTAL	5			
LASH	7	21.5	32	TURBINE
TOTAL	7			
OBO CARRIER	1	80.5	24	TURBINE
TOTAL	1			
BULK CARRIER	2	19	5.4	DIESEL
	1	28	7	DIESEL
	1	23	7.2	DIESEL
	2	59	16	DIESEL TWIN SCREW
	1	26.5	7.2	DIESEL
TOTAL	7			

TOTAL NUMBER OF SHIPS = 87

Ref: Marine Engineering/Log June, 1974 Issue; ABS Register

VESSELS UNDER CONTRACT AS OF MAY '74 IN U.S.A.

TABLE 3-21

APPENDIX A

SHIP TYPE	DWTX1000	1969	1970	1971	1972	1973	TOTAL
Container Carrier	14.6-20	3	6	1	-	-	10
RO/RO Ship	14.1-20	1	-	-	5	-	6
Barge Carrier	22-28	-	-	7	2	-	9
Bulk Carrier	19 29,80	-	-	6	-	5	11
OBO Carrier	80	-	-	2	-	-	2
LNG Ship	64-100	-	-	-	6	9	15
Oil Tankers	25-37	2	-	-	19	9	30
Oil Tankers	70-90	3	2	-	5	10	20
Oil Tankers	120	3	2	2	-	-	7
Oil Tankers	225-265	-	1	1	4	3	9
		12	11	19	41	36	119

SOURCE: Marine Engineering/Log

SHIPS CONTRACTED IN 1969 TO 1973

TABLE 3-22

APPENDIX A

1.	American Shipbuilding Go.	No. of Dry Docks	5
2.	Avondale Shipyards, Inc.	Launching Ways	2
		Marine Way	1
		Dry Dock Capacity 3,300 Tons	
3.	Bath Iron Works	Launching Ways	5
4.	Bay Shipbuilding	Building Berths	3
5.	Bethlehem Steel Corp.	Launching Ways	8
		Building Basin	1
		Repair Dry Docks	17
6.	F.M.C. Corporation	Building Berths	3
7.	General Dynamics Corp.	Building Basin	5
8.	Ingalls Shipbuilding Corp.	No Information	
9.	Lockheed Shipbuilding	Launching Ways	3
10.	National Stel & S.B. Co.	Launching Ways	4
		Dry Dock	2
11.	Newport News	Building Ways	5
		Building Docks	2
		Graving Dock	3
12.	Seatrain Shipbuilding Corp.	Graving Docks	4
13.	Sun S.B. & D.D. Co.	Slipways	4
		Dry Docks	1
		Berths	6
14.	Todd Shipyard Corp.	Building and Dry Docks	16

TABULATION OF SHIPYARD CAPACITIES

TABLE 3-23

SHIPYARD CAPACITY SUMMARY (TABLE 3-23)

The shipyards are specialized in construction and. repairs of both naval and commercial vessels including off-shore drilling structures of different sizes and types. The capability of building commercial vessels include VLCC, LNG carriers, LASH ships, container carriers, Bulk carriers, 080 carriers, tankers and RO/RO ships. The total number of launching ways and building berths are 58 and. number of dry docks are 54. Building berths and launching ways are exclusively for new construction and dry docks are used for repair facilities, conversion and new construction. There are some shipyards, engaged in building barges, tow boats, supply vessels and heavy steel fabrication only but they also have facilities to build commercial ships up to 20,000 DWT.